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# A Comparison of the Attainment of the Common Objectives of the CBA, CHEMS, and *Modern Chemistry* Chemistry Courses as Reflected in Student Performance on Various Objective Measures<sup>1</sup>

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In the February, 1968, *Iowa Science Teachers' Journal* the writer outlined a study in which students in Iowa and Illinois who were utilizing the CBA, CHEMS, and *Modern Chemistry* (MC) chemistry materials were to be studied to determine if these courses were meeting their common objectives equally.

The common objectives of the three courses of study in chemistry as outlined in the *Journal* were such as to indicate that the student utilizing any one set of these materials should:

1. develop a better understanding of science, 2. develop a background in chemistry, 3. develop an appreciation of science in terms of a positive attitude toward science, and 4. develop an ability for critical thinking.

The basic question underlying all of these objectives was whether one or two of these courses of study develops these abilities and understandings in students to a significantly greater degree than the other(s).

Four objective instruments were used on a pretest and posttest basis

and the results of these instruments were analyzed statistically to determine if there were any differences in the attainment of these common objectives through the use of the three chemistry courses. A total of 1,333 students received and answered these examinations. Including all subtest and total test scores each student answered a battery of fifteen examinations.

The objective instruments used in this study were as follows:<sup>2</sup>

1. ACS Cooperative Examination in General Chemistry
  - A. Recall of Information (1)
  - B. Applications of Principles (2)
  - C. Quantitative Application of Principles (3)
  - D. Total Test Score (4)
2. Test on Understanding Science
  - A. The Scientific Enterprise (5)
  - B. The Scientist (6)
  - C. Methods and Aims of Science (7)
  - D. Total Test Score (8)

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<sup>1</sup> The full report of this study may be obtained from the Office of Education, Washington, D.C. Request the report for Project Number 078125.

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<sup>2</sup> Numbers in parentheses refer to test and subtest titles on the tables in this report. The validity and reliability of these instruments are generally available and are included in the full report.

### 3. Watson-Glaser Critical Thinking Appraisal

A. Inference (9)

B. Recognition of Assumptions (10)

C. Deduction (11)

D. Interpretation (12)

E. Evaluation of Arguments (13)

F. Total Test Score (14)

### 4. Prouse Subject Preference Survey

A. Total Test Score (15)

Extreme care has been taken to assure randomization during the selection procedures in order to assure meaningful statistical results.<sup>3</sup> The students were compared on the basis of: 1. the total group without regard to grade level or ability level, 2. each grade level without respect to ability level, and 3. each grade level subdivided into three ability groups as determined by the Watson-Glaser Critical Thinking pretest total score. The comparison was accomplished by analysis of covariance as outlined in the exposition by Lindquist, 1953, and Edwards, 1955. If the F-ratio was statistically significant at the 0.05 level, then a t-test was applied to determine the direction of the significance between the variables tested. Since the covariance and t-test tables are lengthy, they have been put into a summary table for this report. Also, only the summary table for the total group is presented here.

The data in Table 1 compare the total group differences of students who are enrolled in the MC, CHEMS,

and CBA courses. The results of these analyses indicate:

1) Students who are enrolled in CHEMS and CBA tend to develop a significantly better understanding of chemistry than do students enrolled in the MC course, as measured by the ACS examination.

2) Students who are enrolled in the CHEMS and CBA courses tend to develop a significantly better understanding of science than do students in the MC course, as measured by the TOUS examination. Also students enrolled in the CBA course tend to develop a better understanding of science than do students in the CHEMS course, as measured by the TOUS examination.

3) Students in the CHEMS and CBA course tend to develop into significantly better critical thinkers than do students in the MC course, as measured by the WGCTA examination.

4) Students who are enrolled in the CHEMS and MC course have a significantly greater preference for science than do students enrolled in the CBA course, as measured by the Prouse examination. Also students enrolled in CHEMS have a significantly greater preference for science than do students enrolled in the MC course, as measured by the Prouse examination.

The results of this study indicate that the MC, CHEMS, and CBA courses are not meeting their objectives with the same degree of effectiveness. In general, students who use the CHEMS and CBA course materials develop a better understanding of

<sup>3</sup> The discussion of these procedures would be lengthy and is not presented here. Interested individuals can analyze these procedures by obtaining the full report.



chemistry, develop a better understanding of science, and develop a greater ability for critical thinking, as measured by the instruments used in this investigation. Students who are

enrolled in MC and CHEMS develop a greater preference for science than do students enrolled in CBA, as measured by the instrument used in this investigation.

Table 1  
SUMMARY OF ANALYSIS OF COVARIANCE RESULTS FOR THE TOTAL  
GROUP OF MODERN CHEMISTRY, CHEMS, AND CBA STUDENTS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
TOTAL GROUP															
MC															X
CHEMS	X	X	X	X	X	X	X	X	X		X	X	X	X	XX
CBA	-	-	X	X	XX	X	XX	XX	X	X	X	X	X	X	

X Indicates significance over group left blank but not over group marked with a — or another X

XX Indicates significance over the other two groups

+ Numbers 1-15 refer to the subtests and total tests as defined previously in this report

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